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ABSTRACT

The 3-year research and development project described in this paper was conducted (1) to develop new knowledge about sex equity in classroom interactions, and (2) to develop successful techniques for reducing or eliminating sex-biased interaction. Two interventions were developed to train teachers in more equitable instructional behaviors. In the Washington, D.C., metropolitan area, teachers from fourth-, sixth-, and eighth-grade classrooms were trained according to an intervention based on a microteaching model. In New England, teachers of the same grades participated in a training intervention based on a collegial problem-solving model. A comparable group of teachers composed the control group. Overall, the sample consisted of 102 classrooms located in six school districts. All classrooms were observed for 45-minute periods of active interaction by raters trained in the Interactions for Sex Equity in Classroom Teaching Observation System (INTERSECT). Primary analysis of observational data focused on the nature of interaction patterns and the distribution of interaction between male and female students. In the second phase, differences in teacher interaction with boys and girls across treatment groups were examined. Statistically significant differences among conditions and between male and female students were consistent across all approaches to data analysis. (A summary describes selected findings about general characteristics of classroom interaction and about bias reflected in classroom interaction and treatment and control differences. The INTERSECT observation form is also appended.) (RH)

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Teacher Reactions to Classroom Responses of Male and Female Students

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Teacher Reactions to Classroom Responses
of Male and Female Students

Introduction: Recently research has focused on how teachers interact with male and female students in the classroom. The manner in which teachers interact with students may affect student achievement, attitudes and performance. While the literature is not conclusive in this area, the preponderance of research suggests that sex differential treatment of students may characterize the interaction process.

A number of studies have indicated that male students receive more teacher attention in terms of both praise and criticism. In one large study involving 24 fourth and sixth grade classes, teachers interacted more with boys on four major categories: disapproval, approval, instruction, and listening to the child (Spaulding, 1963). Other researchers have also found that boys receive more criticism and more praise (Felsenthal, 1970; Wirtenberg, 1979).

Sikes, (1971) in a study at the junior high school level showed that boys received more academic contacts and they were asked more complex and abstract questions. A study at the secondary school level found striking differences in favor of boys. Boys were asked more direct questions and more open-ended questions; they received more teacher initiated contacts and more total positive teacher-student contacts (Jones, 1971). A study of 105 gifted students revealed that teachers initiated more talk with boys, discriminated significantly

between boys and girls in favor of boys and were more restrictive toward girls (Cosper, 1970).

Research by Leinhardt et. al (1979) disclosed that sex differences in teacher student interaction in second-grade classrooms varied with the nature of the subject matter. Teachers made more academic contacts with girls in reading and with boys in math; teachers spent relatively more cognitive time with girls in reading and with boys in math. Although there were no differences in initial abilities, sex differences were found in end-of-year achievement in reading.

Research at the preschool level showed that teachers gave attention over 1.5 times more frequently to boys than girls who were participating in classroom activities (Serbin et. al., 1973). They praised boys more frequently and were 2.5 times as likely to engage in extended conversation with them. Further, teachers were twice as likely to give male students extended directions, and detailed instruction on how to do things "for oneself." In contrast, they were less likely to explain things to girls. They tended to "do it for them" instead. In her study of sex desegragation at the Coast Guard Academy, Safilios Rothschild (1979) found that instructors were more likely to give males detailed instruction in how to accomplish tasks; in contrast they were more likely to do tasks for female student.

Dweck and her colleagues (1978) found interesting differences in the nature of the praise and criticism teachers gave female and male students. In observing fourth and fifth

grade classrooms, these researchers found that approximately 90 percent of the praise boys received for their academic work was directed at intellectual competence. In contrast for girls, less of their work-related praise, approximately 80 percent, was for intellectual competence. The other 20 percent of the praise girls received for their work was directed at papers following the rules of form. In terms of work-related criticism, the sex differences were even more striking. Approximately half of the work-related criticism boys received was for intellectual inadequacy. The remaining work-related criticism was for failure to obey the rules of form. In contrast, almost 90 percent of work-related criticism girls received was specifically directed at intellectual inadequacy. Girls received little criticism pertaining to violation of the rules of form. A similar pattern emerged from a study by Spaulding (1963) involving twenty-one fourth and sixth grade classes: the boys received more total blame and disapproval, but this criticism was largely for inappropriate conduct. In the areas of disapproval for lack of knowledge or skill, girls received almost twice as much teacher disapproval as did boys.

It is important to note that it is mainly high achieving boys who receive more teacher approval and active instruction, while low achieving boys are likely to receive more teacher criticism. In fact, Brophy and Good (1974) have concluded, "In many ways, insofar as teacher-student interaction is concerned, it makes sense to speak of low achieving boys and high achieving boys, as separate groups rather than to speak

of boys as a single group." Parsons and her colleagues (1979) found that while high achieving boys receive the most praise, high achieving girls receive less praise than low achieving girls, and less than both low and high achieving boys.

Several studies indicate that much of the teacher disapproval male students receive is directed at classroom misbehavior, and that boys are reprimanded more harshly as well as more often than their female counterparts (Jackson and Lahaderne, 1967; Meyer and Thompson, 1963; Lippitt and Gold, 1959). A possible explanation of sex differential patterns of classroom management is that boys misbehave more in schools and, consequently, males are deserving of negative teacher attention. However, one study of 15 preschool classrooms showed that when teachers were faced with disruptive behavior, particularly aggressive behavior from both boys and girls, the teachers were over three times as likely to reprimand the boys as the girls. Further, they more frequently punished the boys through loud and public reprimand. When they did reprimand girls, they did it quickly and quietly in a way that other members of the classroom could not hear (Serbin, O'Leary, Kent, Tonick, 1973). So even when both girls and boys are exhibiting inappropriate behavior, boys are reprimanded more frequently and more harshly. Low achieving boys are most likely to receive this negative teacher attention (Brophy and Good, 1974).

While most research emphasizes teacher-student interaction, some studies have analyzed sex differences in

peer communication. Peer groups that are segregated by sex characterize the elementary school years. Sometimes teachers create this segregation by categorizing students on the basis of gender; they may form separate boy and girl lines, teams for contests, and group for various classroom tasks and assignements (Frazier and Sadker, 1973). Teachers may also influence peer groups and sex segregation by assigning more leadership roles in the classroom to male students (Lockheed, et. al., 1978). However, even when this teacher interference does not occur, children tend to self select into same sex peer groups. Clement and Eisenhart (1979) found that ten-to-twelve year olds sorted themselves into gender-segregated groups whenever the opportunity arose. Within these sex segregated groups, different values and roles were emphasized for boys and for girls. Girls' groups stressed the importance of being "popular", "cute," and "sweet." Boys' groups placed higher value on being "strong", a "good student", and a "good basketball player."

Fox (1977) has found that the adolescent peer group can have a negative effect on female participation in math and science. Many young women in high school perceive strong peer pressure against enrolling in advanced math courses, and mathematically gifted females show reluctance to skip grades due to peer disapproval and rejection. Matthews and Tiedeman (1964) found that a decline in career commitment by high school females was related to their perceptions of male peers' disapproval of a woman using her intelligence.

Several other researchers note that same-sex interactions are more common than cross-sex interactions among elementary school children; children are more likely to cross racial lines than sex lines in classroom interaction (Bossert, 1979; Devries and Edwards, 1977; Willia and Recker, 1973). Grant (1982) conducted ethnographic observations of urban first grade classrooms and found that girls often fulfilled a caretaker or helping role for boys (helping with academic work, tying shoes). Boys were far less likely to demonstrate these behaviors for girls. In contrast girls received more hostile remarks in cross sex interaction and wer more likely to be the "victims of criticism, racist and sexist remarks, and physical and verbal aggression."

Lockheed and Harris (1982) in research in 29 fourth and fifth grade classrooms found students often do not appear willing to work on science projects with cross-sex classmates. However, student held significantly less stereotyped attitudes in classrooms where there was more opportunity for peer collaboration and interaction.

While there have been many reports that teacher behavior may increase sex segregation, there is, at this point, limited research concerning interaction patterns teachers may use to encourage cooperative cross sex work and play. However, Serbin and her colleagues (1977) found that cooperative cross sex play in a pre-school setting can be increased through the use of contingent teacher attention. Teacher praise of

cooperative cross sex play produced a clear increase in this type of student behavior.

Project INTERSECT

The three year research and development project described in this paper was conducted (1) to develop new knowledge about sex equity in classroom interactions; and (2) to develop successful techniques for reducing or eliminating sex biased interaction in the natural classroom setting. Two interventions were developed to train teachers in more equitable teaching behaviors. In the Washington, D.C. metropolitan area, teachers from 4th, 6th, and 8th grade classrooms were trained though an intervention based on a microteaching model. In New England, 4th, 6th, and 8th grade teachers participated in a training intervention based on a collegial problem solving model. A comparable group of 4th, 6th, and 8th grade teachers comprised the control population. All classrooms were observed for three 45 minute periods of active interaction by raters trained in the use of the INTERSECT Observation System. The following sections provice detail on the nature of the interventions, the sample, instrumentation, data collection, methodology and findings.

Interventions

In Washington, D.C., a training intervention based on the microteaching model was implemented. Teachers viewed a videotaped (perceptual model) that portrayed scenarios demonstrating four forms of bias in classroom interaction as well as scenarios showing how to eliminate the bias and attain

equity in interaction. Teachers also read written materials on these same four teaching skills (symbolic model). These four teaching skills focused on equitable distribution of active teaching attention; equitable classroom management; verbal evaluation; and sex integration. After viewing, reading about, and discussing the skills, teachers attempted to demonstrate each of the sex equity skills in small group clinical settings. Teachers retaught the various skills until mastery was reached. Each teacher trained in the microteaching clinic was also visited in his or her classroom at least once during the Fall semester by a trained microteaching supervisor. The supervisor observed the teacher in actual classroom interaction and held follow up conferences concerning the mastery of sex equity teaching skills.

A second intervention, developed in New England, was based on an interactive problem-solving approach. This approach enlisted teachers in a self-improvement effort with peer support but with limited external direction. It was posited that teachers concerned about bias would be able to make changes in their classrooms after some training if they had collegial support and assistance. This intervention was designed to have minimal dependence on outside expertise and to develop and foster professional growth through peer support groups. Teachers were provided with training to recognize sex bias in curriculum and instruction as well as with multiple strategies and resources for changing classroom practices to make them more equitable. They were also introduced to

analytic tools that they (or a student or a colleague) could use to diagnose inequitable classroom interaction patterns in their own classes. Each teacher received a training package to assist their equity efforts. The package was organized accoprding to the project's four target areas -- classroom intergration, equitable teaching attention, evaluation of academic work, and behavior management. The training package included diagnostic tools, strategies for improvement, and planning worksheets. The use of these or other strategies to eliminate bias remained with the teachers at the local level.

Sample

The sample selected for this investigation consisted of slightly over 100 classrooms (N=102), including fourth, sixth and eighth grade classes. These classrooms were located in six different school districts in New England and the Washington, D.C. metropolitan area. The classrooms analyzed in the sample represented urban, suburban, and rural areas as well as two distinct geographic regions of the nation. They also encompassed predominantly majority, predominantly minority, and integrated classrooms, For the purpose of this study, these classrooms were defined as follows:

- predominantly majority -- classrooms in which 75-100% of the students were not members of a minority group
- mixed or integrated -- classrooms in which 35-50% of the students were members of a minority group

- predominantly minority -- classrooms in which at least 75% of the students were members of a minority group

The final sample size for the problem-solving intervention was 24 classrooms; forty-four microteaching classrooms were included in the sample; a total of 34 control classrooms were also observed and coded (from New England and from the Washington-Baltimore areas).

Sample diversity was also achieved in relation to grade level and subject matter. The sample included 35 fourth grade classes, 33 sixth grade classes and 38 eighth grade classrooms. In terms of subject matter, 48 classrooms were language arts, 48 classrooms were mathematics/science, and six classrooms were concerned with other academic subjects.

Thirty-five classroom teachers were black, 66 teachers were white and one teacher was Hispanic. Thirty of these classrooms were taught by males and 72 by females.

Data Collection and Instrumentation

The primary measurement activity of this project was to code, analyze and evaluate classroom interaction. Most currently available coding instruments focus on teacher and student verbal comments in a global way and do not reveal sufficient information concerning which individual students are involved in the interaction. Consequently the INTERSECT Observation System (Interactions for Sex Equity in Classroom Teaching) was designed to record the distribution and nature of teacher comments to students as well as to record the race

are involved in the interaction. Consequently the INTERSECT Observation System (Interactions for Sex Equity in Classroom Teaching) was designed to record the distribution and nature of teacher comments to students as well as to record the race and sex of each student participating in the interaction (See attachment).

INTERSECT contains four major substantive areas of interaction, and four additional areas of evaluative comments. Together, they could be combined into a grid of 16 potential teacher moves. The four substantive or content areas of INTERSECT can be briefly defined as follows:

- o INTELLECTUAL concerned cognitive and academically related topics.
- o CONDUCT included the behavior and deportment of students.
- o APPEARANCE included the attractiveness or adherence to rules of form and neatness in both personal appearance and the appearance of student work.
- o OTHER included all comments which did not conform with the three preceding definitions.

The four evaluative teacher moves were as follows:

- o PRAISE concerned explicit comments which positively reinforced student performance (e.g. "Excellent!" "Good!").

- ACCEPTANCE referred to comments which implied that student performance was correct or appropriate. However these comments were not so clearly and strongly stated as to be categorized as praise (e.g. "OK." "Uh-huh." "I see").

- REMEDIATION represented a constructive teacher comment, usually encouraging or cueing a more acceptable student response. Remediate implied a deficiency in student performance in which the teacher assisted by encouraging corrective action.

- CRITICISM referred to explicity negative teacher evaluation (e.g. "That answer is wrong.").

Using this system an "O.K.", teacher reaction to a student's academic response would be coded in the intellectual-accept category. A harsh reprimand of student behavior would be coded in the conduct-criticize category. By combining the substantive area of classroom interaction with the evaluative component, INTERSECT provided a picture of the variety of teacher-student interaction patterns.

The instrument also recorded how each interaction was initiated. Not only were student and teacher initiations differentiated, but the method of initiation was also coded on the INTERSECT form. The sex and race of each participating student was always recorded, whether the student was responding to a teacher's question or initiating a comment of his or her own.

All raters participated in intensive training in the INTERSECT Observation System and inter-rater reliability was set and maintained at 90 percent. Data were collected from three rounds of observations of all classrooms in the control and treatment conditions.

Quantitative Analysis of Data

The primary analysis of observational data focused on the nature of interaction patterns and the distribution of interaction between male and female students for: total interaction, intellectual interaction, conduct interaction, personal appearance, appearance of work, other interaction, praise, remediation, acceptance, criticism, student initiated interaction, and students calling out.

Overall patterns of classroom interaction were analyzed. Descriptive statistics were compiled for each type of interaction in each condition (microteaching, problem-solving, and control) for observations I, II and III. In addition to standard descriptive statistics (mean, standard deviation, and variance) an indicator of the distribution of interaction among categories of student, in this case male and female students, called the coeficient of distribution was calculated and examined. Following is a description of the coefficient of distribution and method for its calculation.

For each of the above categories, the mean frequency per (30 minute) observation was calculated. Then a coefficient of distribution was calculated for all boys, all girls, all minority boys and all minority girls in these classes. The

coefficient characterized the degree to which the boys, girls, minority girls, and minority boys participated in the interactions proportional to their enrollment in class. For example, the distribution of intellectual praise between males and females in one classroom would be calculated as follows:

1. Count the total number of students in the class (e.g., 25 students).
2. Count the total number of males present, then the number of females (e.g., 10 males and 15 females).
3. Divide the total number of males by the total number of students, then divide the total number of females by the total number of students. This will yield the expected percentage of interactions for each sex.

   Example:

   $\frac{10}{25}$ - 40% (expected contact for males)

   $\frac{15}{25}$ - 60% (expected contact for females)

4. Count the total number of contacts for all students in the category being examined (e.g., the teacher praised students 10 times).
5. Count the total number of times teacher praise was directed at females, then count the total number of times teacher praise was directed at males (e.g., the teacher praised males 5 times and females 5 times).

6. Divide the number of praises for males by the total number of praises for all students, then divide the number of praises for females by the total number of praises for all students. This will yield the actual percentage of interaction for each sex concerning praise.

Example:

$\frac{5}{10}$ - 50% (actual praise for males)

$\frac{5}{10}$ - 50% (actual praise for females)

7. Compare the result in Step 3 (the expected percentage) with the results in Step 6 (the actual percentage). The difference between the two is called the coefficient of distribution. If the coefficient of distribution is a positive percentage, the total interactions being distributed to that sex is more than expected. If the coefficient of distribution is a negative percentage, that sex is receiving less attention than expected.

Example:

50% actual female praise
- 60% expected female praise
- 10% less female praise than expected given the number of females in the class

50% actual male praise
- 40% expected male praise
+ 10% more male praise than expected given the number of males in the class

By combining the mean number of interactions per observation for any group (i.e., grade, condition, demographics) with the coefficient of distribution, it is possible to portray a picture of distribution, frequency and type of interaction found in any given class.

Based on these descriptive statistics we eliminated from further analysis interactions which were so few in number that no reliable estimates of significant differences could be calculated. In the second phase of analysis we examined the difference in teacher interaction with boys and girls across treatment groups using three methodological approaches.

In the first approach we compared the three conditions. The data were aggregated across classrooms within each of the three conditions. The distribution of teacher interaction with males and females was compared in the control and treatment groups. First microteaching classrooms were compared to problem-solving classrooms, and then microteaching and problem-solving classrooms (treatment) were compared to the control classes (See Table 1).

In the second method we analyzed individual classrooms as the unit of measure. Based on the results of a significance test of the coefficient of distribution within each classroom, each class was labelled as significantly favoring boys in interaction, significantly favoring girls in interaction or reflecting no bias in favor of either sex in interaction. A chi-square test was then done to compare the distribution of these classrooms across treatment groups (See Table 2).

TABLE 1 COMPARISON OF TEACHER-STUDENT INTERACTIONS FOR MICROTEACHING AND PROBLEM-SOLVING INTERVENTIONS AND CONTROL GROUP

COEFFICIENT OF DISTRIBUTION BY CONDITION

(1)	(2)	(3)	AVERAGE COEFFICIENT OF DISTRIBUTION (in percentage)		
		Mean	(4)	(5)	(6)
Condition	Number of Classrooms	Interactions Per Observation	TOTAL*	Minority Boys	Minority Girls
OBSERVATION I					
Problem-Solving	24	85	2.0%	NA	NA
Microteaching	43	73	0.7%	-2.0%	-4.0%
Control	35	67	5.0%	-3.0%**	-2.0%**
Test 1: Problem-solving vs. microteaching:				Z = 1.2473	
Test 2: Problem-solving & microteaching vs. control:				Z = -2.5801***	
OBSERVATION II					
Problem-Solving	22	72	4.0%	NA	NA
Microteaching	42	65	-0.2%	-2.0%	2.0%
Control	29	64	4.0%	-6.0%**	-0.09%**
Test 1: Problem-solving vs. microteaching:				Z = 2.7211***	
Test 2: Problem-solving & microteaching vs. control:				Z = -1.1909	
OBSERVATION III					
Problem-Solving	23	60	4.0%	NA	NA
Microteaching	44	68	0.1%	0.1%	0.3%
Control	30	64	7.0%	-3.0%**	-5.0%**
Test 1: Problem-solving vs. microteaching:				Z = 2.1120	
Test 2: Problem-solving & microteaching vs. control:				Z = -3.8555***	

* A positive number indicates that boys are receiving greater frequency than expected; a negative number indicates that girls are receiving greater frequency than expected.

** This statistic applies only to part of the control group where minorities were present. During Observation I it applies to 17 classrooms, during Observation II, 15 classrooms, and during Observation III, 15 classrooms.

*** $p \leq .01$, i.e., $Z > 2.58$ or < -2.58

TABLE 2 TOTAL TEACHER INTERACTIONS WITH STUDENTS IN THE CLASSROOM

LEVELS OF SIGNIFICANCE USING THE CLASSROOM AS THE UNIT OF MEASUREMENT

(1) Condition	(2) Number of Classrooms	Percentage of Classrooms Which* (3) Favor Girls	(4) Reflect No Bias	(5) Favor Boys
OBSERVATION I				
Problem-Solving	24	16.7%	54.2%	29.2%
Microteaching	43	9.3%	81.4%	9.3%
Control	34	2.9%	70.6%	26.5%
	CHI-SQUARE = 8.8131		P ≦ 0.0659	
OBSERVATION II				
Problem-Solving	22	13.6%	54.5%	31.8%
Microteaching	42	7.1%	88.1%	4.8%
Control	29	6.9%	75.9%	17.2%
	CHI-SQUARE = 10.1348		P ≦ 0.0382	
OBSERVATION III				
Problem-Solving	23	8.7%	73.9%	17.4%
Microteaching	44	9.1%	70.5%	20.5%
Control	30	3.3%	56.7%	40.0%
	CHI-SQUARE = 5.0971		P ≦ 0.2775	

* Each class is determined to be in one of these three categories by the following criterion: that the coefficient of distribution significantly differs from 0 at the .05 level.

For selected interaction data, additional analyses were performed. These analyses provided data on both the total number of interactions and the difference between interactions directed at boys and girls. The results of this three way multivariate analysis (treatment x subject x grade) was only done for Observation I and III data (See Table 3).

For this third methodology, while the coefficient of distribution was an adequate descriptor for a teacher/classroom, it could not readily be used for between teacher/classroom comparison. The main problem in using this coefficient for comparison is the fact that the computed index for each teacher/classroom is a sample statistic based on observations obtained from that teacher/classroom. Because of the differences in composition of the classrooms, (e.g., ratio of boys to girls, the total number of observed interactions between teacher and students), the sampling characteristics of these indices are different from teacher to teacher. As a consequence, the usual data analysis procedures based on the linear model are not applicable.*

As an alternative we developed a conceptual model to account for the teacher-student interaction in each classroom, so that an appropriate distributional model can be obtained for the index.

* This third methodology was implemented and described by William Schmidt and Richard Huang, Michigan State University.

Table 3 Multivariate Analysis of the Frequency of All Interactions (Observation III)

Dependent Variables:
1. Total number of interactions
2. Total number of interactions of boys - girls (difference)

Covariables:
1. Total number of students
2. Number of boys - number of girls in class
3. Total number of interactions

Independent Variables: Grade (4, 6, and 8 grade)
Subject (primarily language arts and mathematics)
Treatment (microteaching, problem-solving and control)

Source of Variation	Mean Square	Multivariate F	Univariate F	Degree of Freedom	Significance Level	
Grand Mean		23.05		2.76	.0001	
Total	15380.10		46.70	1.77	.0001	
Difference	151.57		.66	1.77	.419	
Grade (G)		3.65		4.152	.007	*
Total	2549.95		7.74	2.77	.001	*
Difference	11.00		.05	2.77	.953	
Subject Matter (S)		1.09		2.76	.340	
Treatment (T)		2.34		4.152	.057	
G x S		.93		4.152	.451	
T x G		1.57		8.152	.138	
T x S		1.12		4.152	.348	
T x G x S		1.21		8.152	.294	
Within Cell						
Total	329.34			77		
Difference	229.91			77		
Within Cell Regression		10.36		4.152	.0001	
Total	115.31		.35	2.77	.706	
Difference	5386.88		23.43	2.77	.0001	

* indicates a significant relationship

In this study, the multinominal model was used to mocel classroom interaction between teacher and students. In this model, each student is assumed to have a probability of p_i, i=1..., n, (where n is total number of students) of being called upon by the teacher at any given instance of interaction. Thus, the sum of the p_i's is equal to one. Assuming that each instance of interaction occurs independently, then for fixed T, the total number of observed interactions, the observed frequencies of interaction, t_1, t_2,.....t_n, between the teacher and each of the n students, will have a multinominal distribution with parameters, T and the p_i's.

In this study, since it examined sex equity in classroom interaction, it is further assumed that the p_i's are constant for boys and for girls. That is, $p_i = p_b$, if the ith student is a boy, and $p_j = p_g$, if the ith student is a girl. This means that all boys are equally likely to be called upon by the teacher with probability, p_b, and likewise, all the girls with probability, p_g. If $p_b = p_g$, then the teacher does not favor boys over girls or vice versa.

Using the method of maximum likelihood, the maximum likelihood estimator, $\hat{p}_b$, for p_b is equal to t/bT, where t is the total number of interactions involving boys, b is the total number of boys in the class and T is the total number of interactions observed. (This maximum likelihood estimator is also an unbiased estimator for $\hat{p}_b$.) When T is large, this estimator is normally disributed, with an asympotic variance,

$p_b(1-bp_b)/bT$. Thus for large T, the sampling variance of p_b can be substituting p_b for p_b.

The asymptotic result can also be used to test hypothese about sex equity in classroom interaction in a particular classroom. If there is no sex bias, p_b should equal p_g. Since the sum of of the p 's must equal one, this implies that $p_b = p_g = 1/n$. Then a test of the null hypothesis, $H_o : p_b = 1/n$ will be a test of no sex bias in classroom interaction. When T is large, the test statistic,

$$z = \frac{\hat{p}_b - 1/n}{(V(\hat{p}_b))^{1/2}}$$

, where $V(\hat{p}_b)$ is the estimated sampling variance by substituting 1/n for $\hat{p}_b$,

will be approximately normally distributed with mean zero and variance one. Interestingly, the numerator of the test statistic is a linear transformation of the coefficient of distribution differed by a factor of b. In other words, a test of the $H_o : p_b = 1/n$ is equivalent to the hypothesis that the coefficent of distribution equals zero.

Given the conceptual model described above, it can be seen from the asymptotic variance of p_b, that the variance for each observation (i.e., the sample coefficient of distribution for each teacher) will be different from teacher to teacher. Thus, traditional methods of data analysis, which are based on the linear model and the assumption of homoscedastcity, will not be appropriate. These include t-test, analysis of variance

and regression analysis. Alternatively, two different approaches will be discussed.

In order to compare the effects of the planned interventions, one approach is to use the test statistic developed in the previous section to test the hypothesis of sex equity in classroom interaction for each teacher. Then the teachers for whom we observed sex equity in classroom interaction can be tallied and compared among the three treatment groups (microteaching, problem-solving and control) using the Chi-square test of independence. This approach allows the researcher to determine whether or not the interventions have any effects when compared with the control group. If the Chi-square test is significant and the proportion of inequitable teachers is highest for the control group, the researcher can conclude that teachers who had received the training re more likely to promote sex-equitable classroom interaction.

This vote-counting method, however, fails to account for those changes in magnitude and direction which do not affect the vote counts. The vote-count method requires a yes/no decision about sex equity in interaction in each classroom. Therefore, a teacher who was extremely inequitable about interacting with boys and girls both before and after an intervention would have the same "no" score as a teacher who has been inequitable prior to the intervention but had become equitable to a degree just short of statistical significance. This distortion in multiple classrooms within any one

treatment group could lead to erroneous conclusions concerning the effects of interventions. Even though the interventions may have a significant impact on the patterns of interaction, the Chi-test of independence fails to yield a significant result.

To deal with this problem the second approach is to estimate the coefficient of distribution directly for each teacher/classroom. Since the estimated coefficients are asymptotically normally distributed, assuming that each teacher behaves independently, it is safe to assume that the estimated coefficients (for all teachers in the three groups) will have ajoint multivariate normal distribution with a diagonal variance-covariance matrix. (That is, the sample variance for each estimated coefficient will be on the diagonal and zero elsewhere.) Any linear combination of these estimated coefficients will be approximately normally distributed with the variance made up of sample variances of the estimated coefficients.

If the above is true, hypotheses about treatment differences can be tested using contrasts. If there is more than one contrast to be tested, the Bonferroni inequality can be used to control for the overall Type I error rate. Each of these contrasts can be tested using the standard normal distribution as the approximate referenced distribution. To interpret the statistical significant results, the researcher must keep in mind that the contrasts are based on the average estimated coefficients for each group. The differences among

treatment groups could be due to a few cases of extreme values in each group. If the differences are caused by extreme values in each group, then concluding that there is an overall treatment effect is unjustified.

Although this approach allows the treatment of the size of "effect" directly, the inferential procedure depends on treating the teachers as a "fixed" sample. The use of the term "fixed" is similar to that in the context of analysis of variance, (e.g., "fixed" effects), or that in the context of regression analysis, (e.g. "fixed" predictors). In other words the inferential procedure does not take into account the fact that the teachers represent a random sample from some well-defined population for which inferences are intended. In this approach, statistical inferences are limited to the same group of teachers being observed possibly at different times.

Findings concerning statistically significant differences among conditions and between male and female students were consistent across all approaches. A detailed display and discussion of each analysis can be found in Promoting Effectiveness in Classroom Interaction: Year 3 Final Report. Sadker, Sadker, Bauchner, Schmidt, Huang, and Schmeltzer, NIE, March 1984. Below is a summary of selected findings.

Findings

General Characteristics of Classroom Interaction

o In all conditions the frequency of classroom interaction decreased as the grade level increased at a marginally significant level.

o Generally, the frequency of classroom interaction decreased slightly as the school year progressed.

o On the average there were slightly more than two teacher-student interactions per minute in all classrooms observed.

o Praise constituted a fairly low proportion of total classroom interaction. On the average it occured only seven times per observation in the typical (control) class and constituted approximately 11 percent of all interaction.

o In approximately 25 percent of the typical (control) classes, teachers never praised students.

o Acceptance was the most frequent teacher response in all classrooms observed. It appeared in all classrooms and accounted for more interaction than praise, criticism remediation combined.

o On the average acceptance occurred more than once a minute and it accounted for approximately 60 percent of all interactions in the typical (control) classroom.

o Remediation occurred in 99 percent of the classrooms observed, averaging almost one remedial interaction per minute. It was the second most frequent interaction comprising approximately one third of all classroom interaction.

o Of the four teacher reactions, criticism occurred in the fewest number of the classrooms. Approximately two-thirds of the classrooms observed contained no criticism.

o Approximately 39 percent of the typical (control) classrooms contained no criticism.

o In the 37 percent of the total classes observed that contained criticism, the average occurence was only slightly more than three interactions per observation or only 5 percent of the total interaction.

o All classrooms contained intellectual interaction. Approximately three out of every four classroom interactions was intellectual. In terms of specific types of intellectual interactions the data showed:

	Percentage of Typical (control) Classrooms Using Intellectual Interaction	Average Frequency per observation in typical (control) class
Accept	100%	28
Remediate	98%	14
Praise	73%	6
Criticize	29%	2

o In all classrooms the frequency of intellectual interaction, as with interaction generally, decreased as the grade level increased. The difference between the sixth and eight grades was statistically significant.

o Conduct interactions occured in 89 percent of the typcial (control) classrooms observed and averaged about 4 interactions per observation. In terms of specific types of conduct interaction, the data showed:

	Percent of Typical (Control) Classrooms Using Conduct Interaction	Average Frequency per Observation in Typical (Control) Classrooms
Remediation	89%	4
Criticism	22%	2
Acceptance	13%	1
Praise	3%	NA

o By far, the most frequent type of conduct interaction was remedial in nature, occuring in more classrooms (91 percent) and at a higher rate (an average of 4 per observation) than all other types of conduct interactions combined.

o Teachers used praise less than acceptance, remediation or criticism when dealing with student conduct.

o All of the typical (control) classrooms contained "other" interactions. These interactions occured at an average rate of 13 times per observation.

o In approximately half of all classrooms there were students identified as salient because they received more than three times their proportional share of classroom interaction. These few salient students received more than 20% of all classroom interaction. In contrast, approximatley 25% of all students in all classes did not participate in classroom interaction.

Bias as Reflected in Classroom Interaction

o Boys participated in more interactions than their representation in the class would lead one to expect. In contrast, girls participated in fewer interactions than their representation would indicate. This inequitable distribution of attention became greater as the year progreses.

o Majority (white) students participated in more interactions than their representation in the classroom would lead one to expect. In contrast, minority students participated in fewer interactions than their representation would indicate.

o Although boys participated in more acceptance interactions than girls, there was less bias in the distribution of acceptance, than in the distribution of praise, remediation or criticism.

o The distribution of acceptance interactions became more biased over time. By the final observation in one out of every four control classrooms teachers favored boys in the frequency of acceptance interaction.

o In all observations and conditions, boys received more remedial interactions than girls.

o In all conditions and at all times boys received more criticism than girls.

o In the typical (control) classes teachers had more intellectual interactions with boys than with girls, and this difference increased as the school year progressed.

o Of the four intellectual interaction types, intellectual remediation and intellectual criticism were the most inequitable in favor of boys.

o Minority students received fewer intellectual interactions than majority students in the typical (control) class.

o In all classrooms and at all observations, boys received more conduct interactions than girls.

o In the typical (control) classrooms, minority girls received fewer conduct interactions than their proportion of the class. Minority boys, while receiving more conduct interaction than expected by their representation received less than majority boys. In fact, minority students generally received fewer conduct interactions than majority students.

o In general, girls and minority students received fewer "other" interactions than expected by their representation in the classroom population.

o Approximately 15 percent of the classrooms observed were biased in the distribution of "other " interactions and this bias more frequently favored boys.

o As boys called out in class, they received more teacher attention and more interactions with the teacher, especially intellectual interactions. In contrast, as girls called out in class, they did not receive more intellectual interaction with the teacher. What they were more likely to experience was a higher frequency of conduct remediation responses from the teacher.

Treatment and Control Differences

o Microteaching classes had a slightly higher frequency of interactions than the control classes.

o The microteaching classes were the most equitable of the three conditions. They were at virtual equity in distribution of interactions between boys and girls by the third observation.

o Although the statistical significance varied across the three analytical procedures, in intervention classrooms teachers generally interacted more equitably with boys and girls than did teachers in control classrooms.

o By the third observation, in 40% of the typical (control) classes teachers were participating in more interactions with boys than with girls. This inequitable interaction ocurred more than twice as much in control classes than in treatment classes.

o Teachers praised boys more than girls in control and problem solving classes, although not at a statistically significant level.

o Teachers praised students more frequently in the microteaching condition than in the control and problem-solving conditions combined. This difference was statistically significant.

o Although not statistically significant, in the microteaching intervention teachers praised students in a more equitable manner than did teachers in either of the other conditions.

o The microteaching condition had the lowest frequency of acceptance interactions while the problem-solving condition had the greatest frequency and this difference was statistically significant.

o The distribution of remedial interactions was more equitable in the treatment conditions than in the control condition at a statistically significant level.

o Microteaching had more intellectual interactions than the other conditions at a statistically significant level. The greater frequency of intellectual interactions in the intervention classrooms as compared to the control classrooms was statistically significant.

o There was more intellectual acceptance in the microteaching condition than in the other conditions at a statistically significant level.

o Intellectual interaction was more equitable in the treatment condition than in the control condition at a statistically significant level.

o Of the three conditions microteaching was the most equitable in the distribution of intellectual praise, remediation and criticism. Problem-solving was most equitable in the distribution of intellectual acceptance although not at a statistically significant level.

o Of the three conditions, control classrooms had the highest frequency of "other" interactions and microteaching classes had the lowest.

o Of the three conditions microteachirg had the most equitable distribution of "other" interactions, although not at a statistically significant level.

Summary: Findings of this three year research and development project appear to lend further documentation to an extensive line of research indicating differences in the way teachers interact with male and female students in the classroom. This study's findings indicate that 4th, 6th, and 8th grade boys participated in more interactions that did their female counterparts. They received more praise, acceptance, remediation and criticism. They received more intellectual interactions, conduct interactions and "other" interactions. It should be noted that many researchers have linked participation in classroom interaction to achievement and positive attitudes toward school. It also should be noted that acceptance was the least biased teacher response category. Of the four teacher reactions analyzed in this study, acceptance is the most diffuse and appears to be the least helpful in providing students with specific feedback, an instructional behavior often mentioned as important in the literature on effective teaching.

This study indicates that boys appear to be more aggressive in initiating interaction or calling out comments and responses to the teacher. However, the study also shows that when boys call out responses, teachers react with an intellectual response. In contrast, when girls call out comments, the typical teacher response is remediation for inappropriate conduct.

This study also generated knowledge concerning interventions for reducing or eliminating sex bias in the ways

teachers respond to female and male students. In most areas, intervention classrooms were successful in eliminating bias from teacher student interaction. Microteaching classes were the most equitable of the three conditions. It is interesting to note that in intervention classes not only was interaction more equitable but it was more intellectual in nature as well.

Teaching should be an intentional and active process rather than one that is passive and reactive in nature. When teachers become aware of differences in the way they interact with male and female students and when they receive appropriate resources and training, they can become more equitable in their response patterns. Moreover interventions for attaining equity in classroom interaction appear to be related to the intellectual level of classroom discourse; this potential interface between equity and excellence in the teaching process is an area worthy of further research and investigation.

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Observer	Date	School	Grade Level	# ID

INTERSECT Observation Form

Time _____ Subject/Teaching Content _____

1	2	3	4	5	6	7	8	9	10
Teacher Initiates to:	BY	Student Initiates	IN	Praise	Accept	Remediate	Criticize	Comment	Ancillary Teacher Behavior
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal
M F G R B W H A O	HAND MOVE CALL OUT	M F G R B W H A O	Private	P-I P-C P-App^{W} P-O	A-I A-C A-App^{W} A-O	R-I R-C R-App^{W} R-O	C-I C-C C-App^{W} C-O		Attribution A Eff X Short Circuit: Physical Verbal